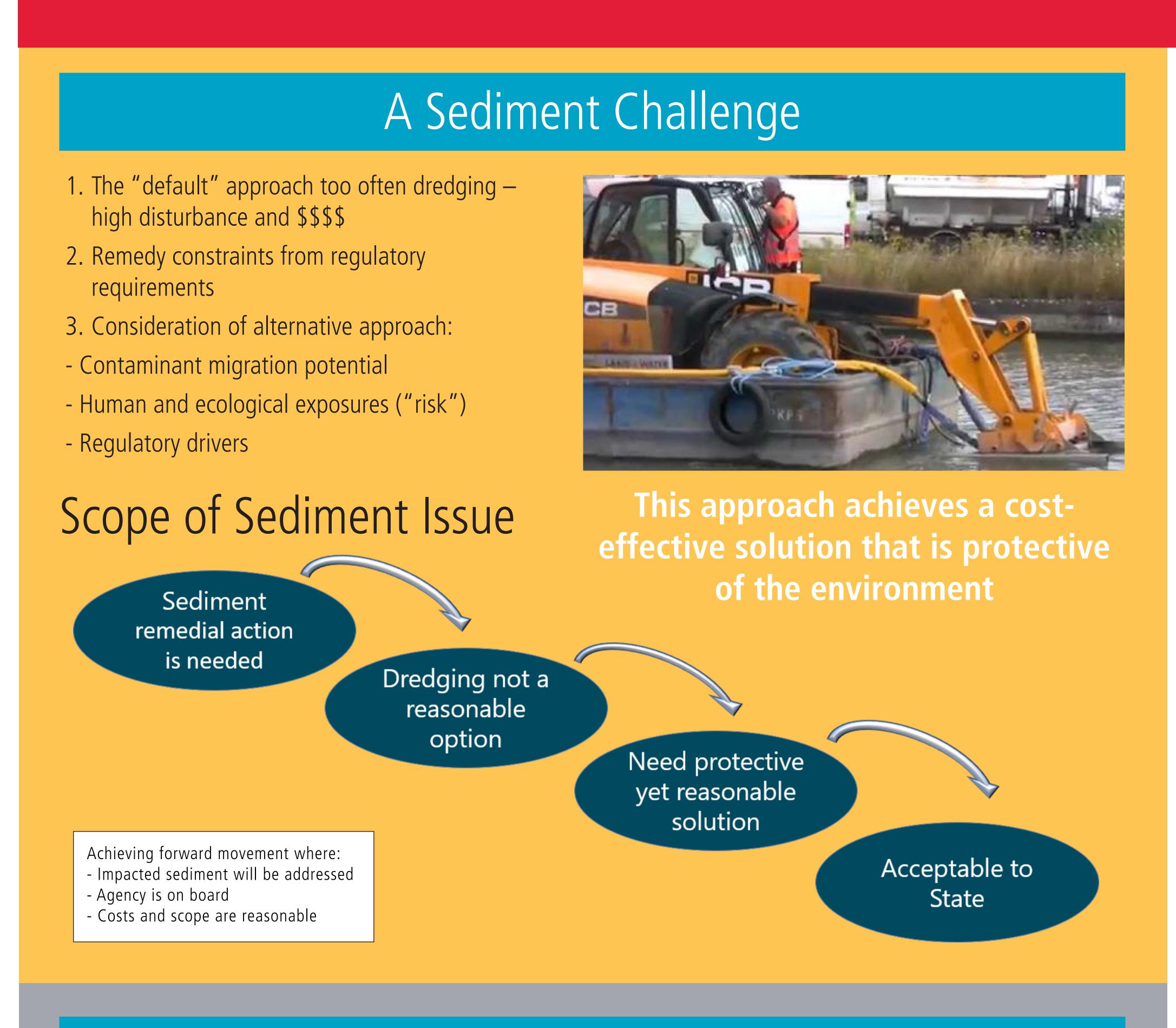
Site Management Decision Strategies: Case Study of a Sediment Remediation Decision Framework

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Site and Regulatory Context

Site Context

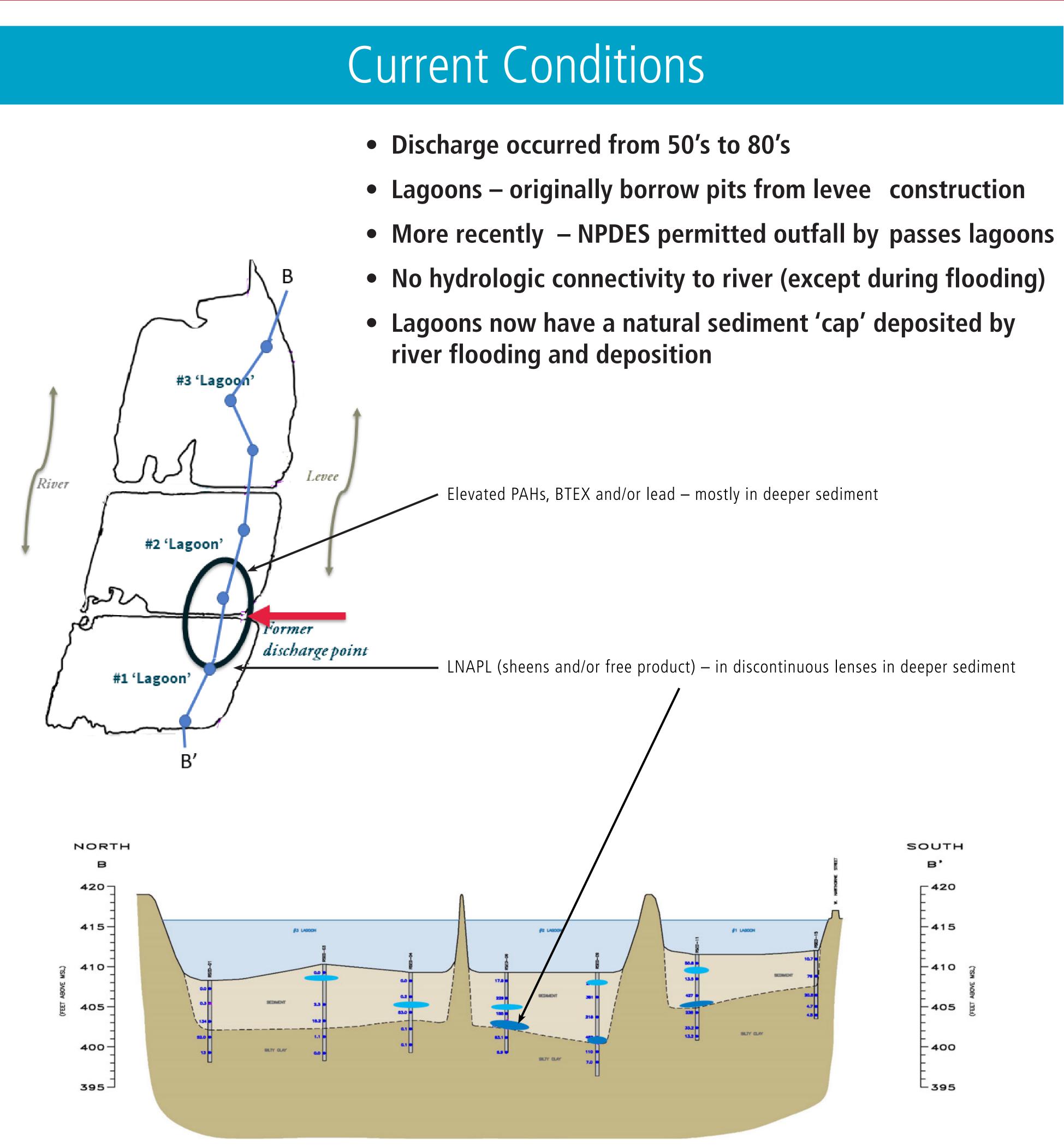
- Former petroleum facility multiple operators over time
- Previous investigations and remediation – mostly upland areas
- River-side 'lagoons' formerly received waste water-limited investigation

Regulatory Context

- We developed strategic plan to address environmental concerns – including sediment
- Strategic plan breaks logjam now with approved path forward from Agency
- This presentation focuses on the strategic aspect

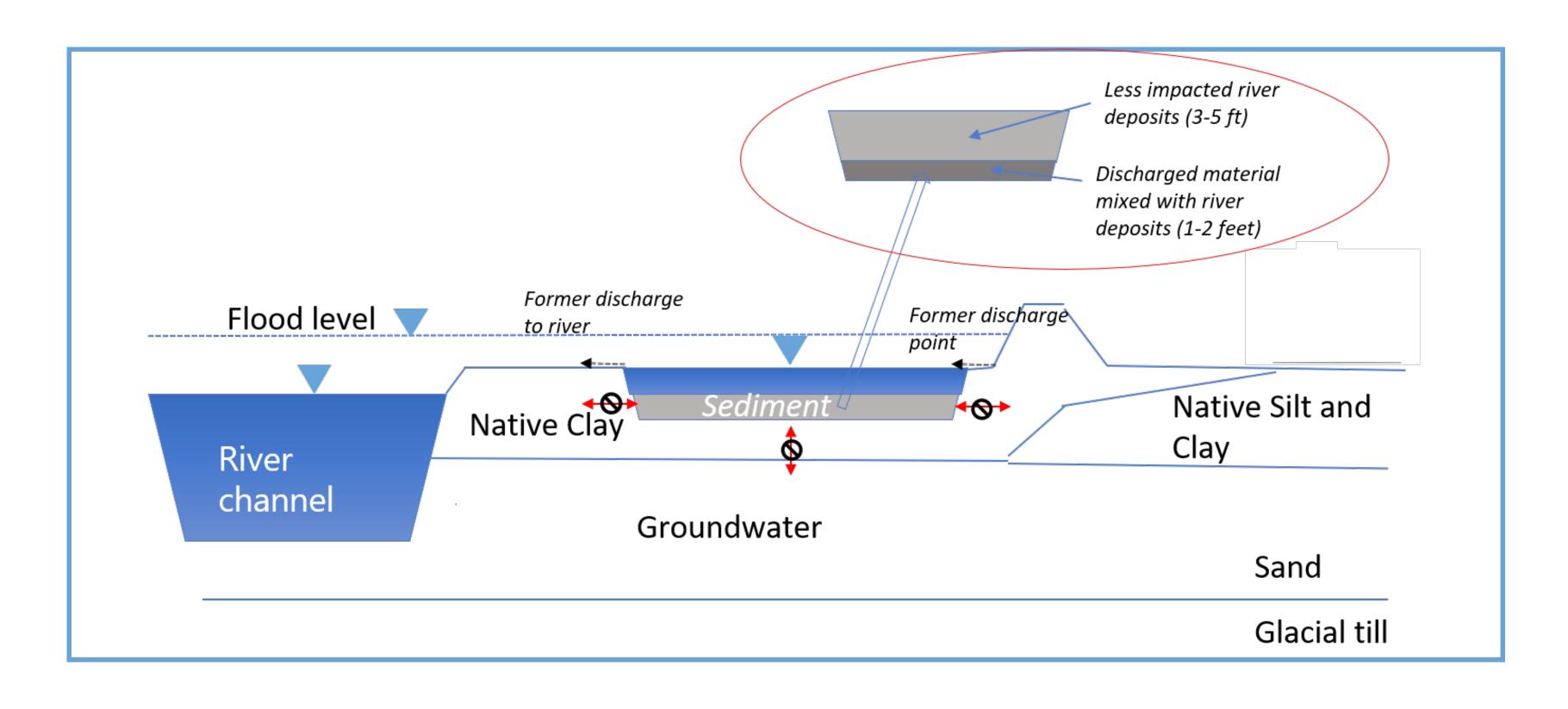
Contact Information

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Figures from sediment investigation Work Plan, courtesy GEI Consultants, Inc., and St. John-Mittelhauser, Inc.

Conceptual Site Model



Decision Strategy

Regulatory Constraints

- Risk based closure appropriate
- When sediment toxicity and/or benthic community integrity risk acceptable
- When engineering and institutional can control human access and exposure
- Conditions for risk based closure are likely present in most but not all the system
- But regulations constrain risk based approach
- 'Free product' precludes risk-based approach
- Material exceeding TCLP criteria precludes risk-based approach

Starting Position

- Agency initially favored removal remedy
- Cost for dredging prohibitive
- Sampling costs to delineate discontinuously distributed impacts very high

Remedial Strategy

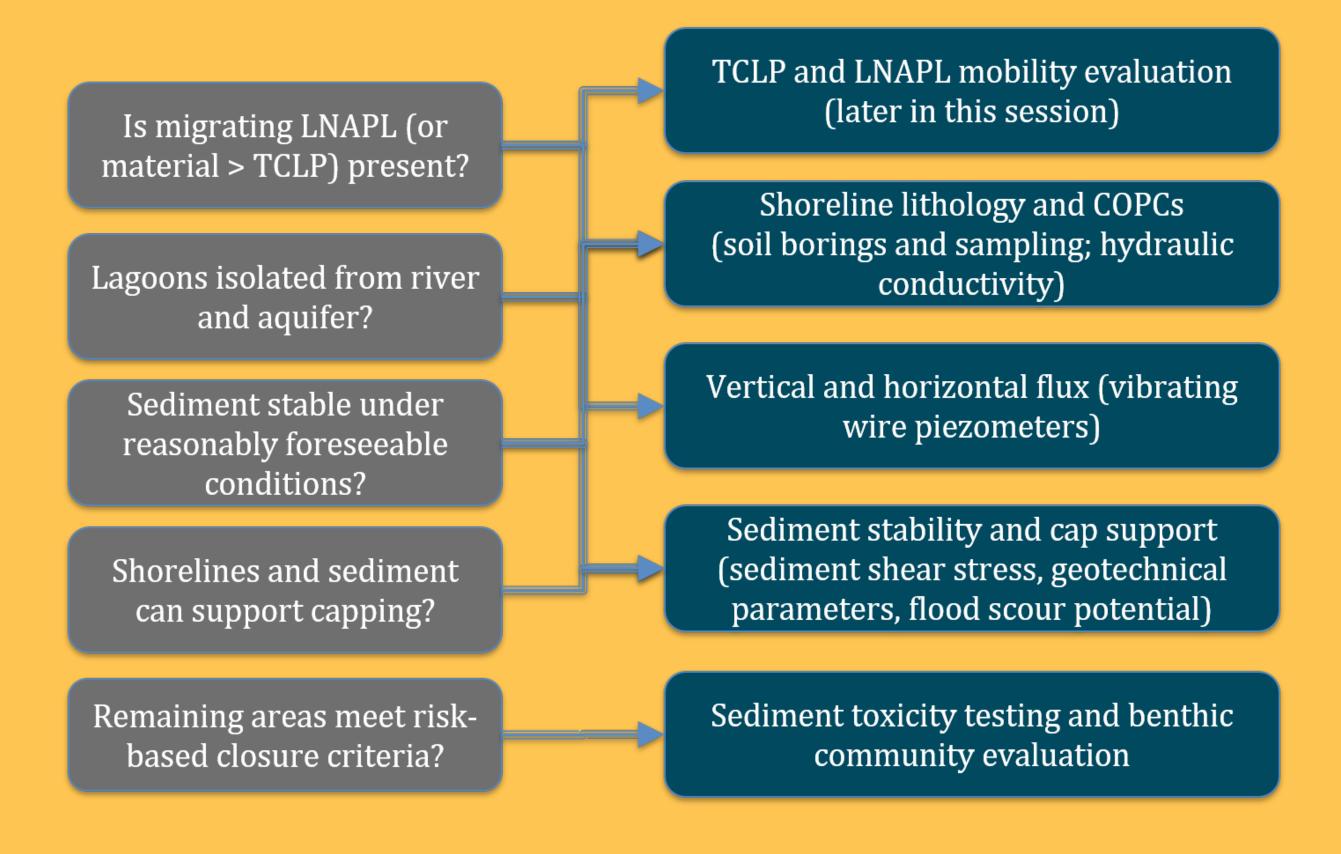
- To define remedy without extensive additional sampling
- To define remedy protective under current and future conditions
- To meet regulatory requirements

Path Forward

- Presumptively suitable to subaqueous capping (amended and/or simple)
- Cap throughout with GAC amended materials to address uncertainty about nature and extent
- Consider additional remedy (including spot removal) for areas with "migrating" LNAPL and material exceeding TCLP limits
- Discussions held with State on data and path forward strategy

The remediation strategy approach has been accepted by the state.

Implementing the Strategy: Decision flowchart

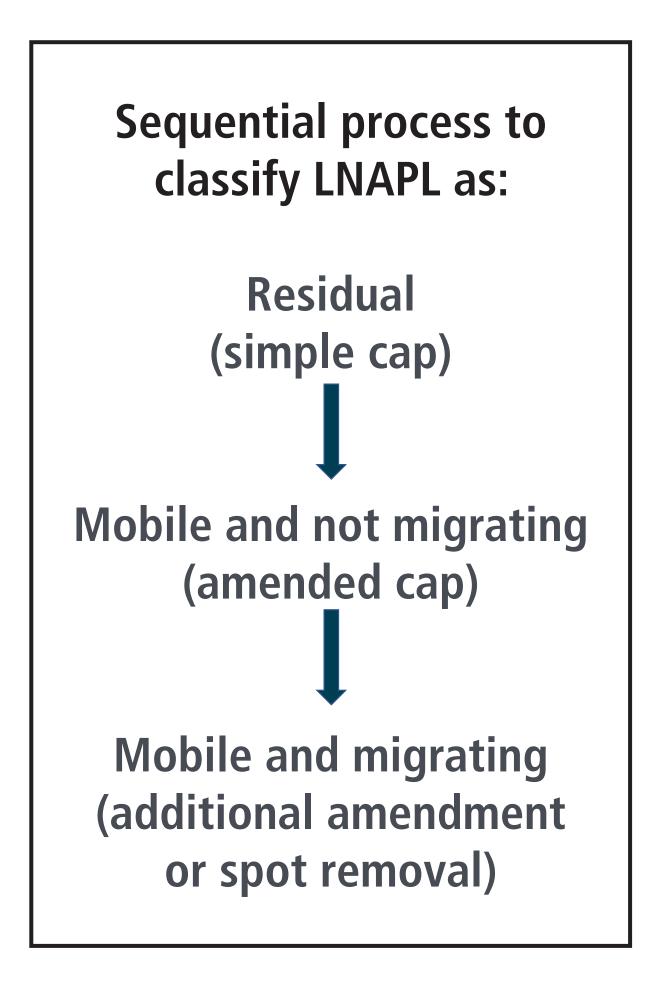




Data Needs

LNAPL Mobility (and TCLP)

- LNAPL Mobility (and TCLP)
- TCLP elevated lead and benzene co-located with LNAPL – evaluate if exceeding TCLP limits
- LNAPL: Migrating LNAPL evaluation
- UV and visible light photography
- ✓ Water drive mobility API RP 40
- Pore fluid saturation (API RP40/Dean Starkwell extraction)
- ✓ Flexible wall permeameter (ASTM D5084)
- LNAPL fluid properties and site hydrogeology



Group 2

The details of the LNAPL classification process was presented in a platform session at this Battelle conference. We hope you had a chance to see it. If you have questions or would like to learn more about it or other component of this presentation, feel free to contact any of the coauthors.

Sediment Stability

- Vane shear strength testing
- Sediment consolidation water
- Flood scour potential

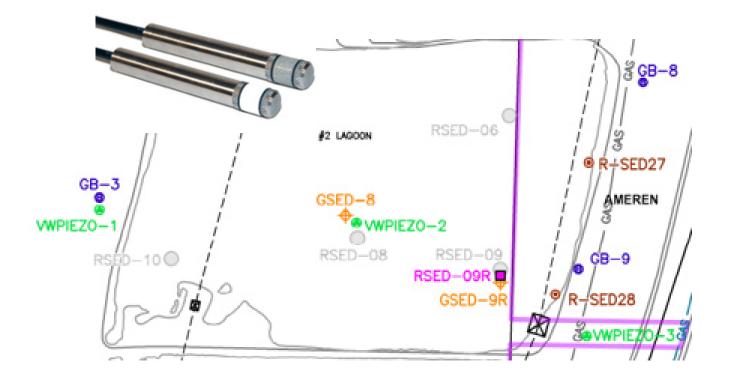
Shoreline Stability and lithology

- Soil lithology around perimeter of lagoons
- Hydraulic conductivity testing
- Geotechnical parameters

Vertical and horizontal flux

- Vibrating wire piezometers shoreline and in lagoons
- Monitoring program encompassing seasonal variability





Expected Outcome

- Lagoon sediment is stable and suitable for capping
- GAC amended cap will address most impacts
- Area of migrating NAPL and/or exceeding TCLP small or absent and can be addressed via additional amendment or spot removal